"JOURNAL OF THE CONSTRUCTORS CLUB"

Hot Iron

Autumn 2011
Issue 73

Contents

The Walford Electronics website is also at www.walfordelectronics.co.uk

Editorial

The start of yet another year! So to be different I invited Nick Tile to write something for this slot. He writes:-

As an Environmentalist, the QRP movement is inspirational. Over the last few years, I've watched the radio amateur go from being a very capable and competent artisan who could turn his hand to building or repairing his radios, capable of adapting what he had to hand, often improving it, re-using parts and sharing knowledge and components with other amateurs, to a completely different breed. Arguably, they are still technically very competent, but they are people who buy expensive equipment who wouldn't dream of opening it up, it's too expensive, too complex and anyway, it isn't repairable or adaptable.

Through the good offices of people like Tim, G3PCJ, George, G3RJV, Eamon, EI9GQ, Bill N2CQR over at Soldersmoke, and the army of unsung heroes who have participated in, and driven forward, a sort of "grass roots" movement, we have seen a new version of the old fashioned amateur rising slowly, typified by the QRP'ers. People who do more for less, use greatly reduced component counts, every part there for a purpose, simplicity a virtue and performance not compromised, or better still, appropriate. These are people who have adopted QRP as a philosophy, people who have looked at technology, and seen its limitations, or simply tinkerers and "Makers".

From my perspective as someone who is concerned about the Environment, these are the people who are setting the blueprint for the way that society is going to have to live. We have all heard the arguments about Carbon Dioxide and climate change, and we all stand in a slightly different place, but in truth, that really isn't the issue. The real issue that we all need to address is consumption, we use too much of everything, we have forgotten how to adapt, repair and re-use the way that you, the QRP movement, does. `Society has to recognise that we can no longer simply rely on technology, we have to start re-learning the process of using our ingenuity, to use fewer resources because they are all limited and therefore precious, so we should be squeezing every last drop from them. We have to learn to start our own "junk-box" of parts that might be useful one day, and how to utilise it in everyday life. Every aspect of the way that you conduct yourself as a QRP enthusiast is relevant to society, and a lesson that it has to learn if it is to survive. You may not appreciate it, but you are brave new pioneers, teaching society how it SHOULD be living from the bottom up, you are demonstrating that you can achieve just as much without the burden of what isn't needed. You have the courage to experiment and fail because you know that trying something that doesn't work is a successful experiment demonstrating what won't work and why. You have the social responsibility to re-use and to share parts, components, and most importantly of all, knowledge. You are helping to write the blueprint for a new society, and you are doing the experiments that prove it can, and must work, and maybe most powerfully of all, your chosen medium is one that ignores all the usual boundaries and constraints, so that your philosophy can be shared to reproduce and grow as new ideas.

Gentlemen, and ladies of course, you might not appreciate it, but you might just be the future.

Hot Iron is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics– is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

Developments and the Minster 2

Firstly my apologies for the small sized type on the front page but I didn't want to cut a guest editorial down! It has been mighty hectic here all summer, farm and kit supplies have been busy, and oragnising QRPiC 2011 took up much time too! I had difficulty getting Clubs to come and show what they are up to, so if any of you, have any influence over you local Clubs who might attend next year, then please start lobbying them to come along and show us all the interesting things you get up to!

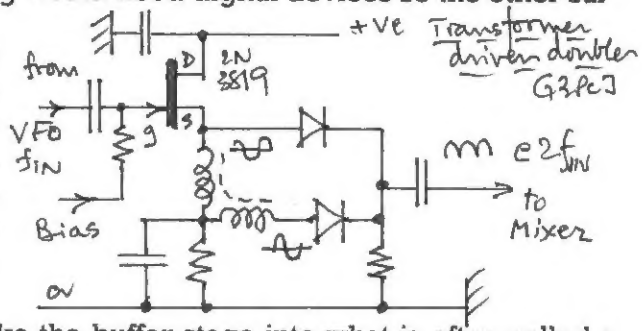
As for new projects, I have not been able to do much except press on slowly with the Minster 2. When away I had a rethink about the frequency scheme with, I think, a little improvement! To remind you, the basic rig is intended to be a builders choice any band 20 - 80m superhet with a single set of parts. The IF is to be 6 MHz so this leads to these local oscillator frequencies (MHz):-

Band	3.5	7.0	10.1	14.0
LO freq	2.5 or 9.5	1 or 13	4.1	8

Additive or subtractive LO mixing is possible in the basic rig as the CIO can be easily placed on either side of the 6 MHz IF. However, THE problem band is 40m; at 13 MHz the VFO would be too high to be sufficiently stable & 8 MHz is plenty high enough for 20m! The 40m alternative of 1 MHz is challenging for the VFO inductor!! I planned to use a T50-2 toroid with the number of turns being adjusted to suit each band so avoiding different types of TOKOs for the different bands. But it is impractical to use a T50-2 for a 1 MHz VFO because it would need about 80 turns to get sufficient inductance and none of you would like winding on that many turns!

This problem has caused me much head scratching over the years. One alternative would have been a digital VFO producing square waves for the LO signal and to make the mixer work on the LO third harmonic. I tried this out and it certainly works but the mixer voltage gain drops from about x10 down to nearer unity. It also needs quite high LO drive levels which could feed through into subsequent stages. Apart from that, few other aspects of the rig would need digital devices so the other surplus gates within a single chip might well be wasted!

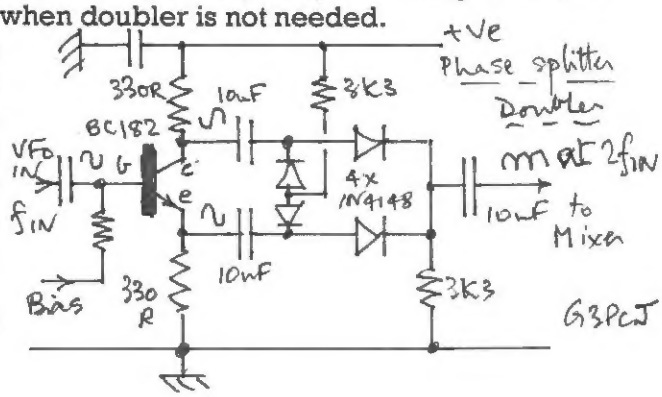
But I then thought of using a frequency multiplier in the VFO chain. The Minster is to have a VFO buffer stage anyway and this could be adapted as a doubler for some bands. The obvious approach is a full-wave rectifier driven by a toroid transformer producing anti-phase signals. The drawback is it needs quite low impedances if one is to not have masses of turns on yet another awkward toroid! This approach is sketched right.



Another scheme for a full wave doubler is to make the buffer stage into what is often called a phase splitter; this is essentially a buffer but with equal resistances in emitter and collector (if a bipolar device). This causes equal amplitude signals in anti-phase to be available at the emitter and collector. Because they carry DC bias voltages one cannot just input those into the full wave rectifier - some form of DC restoration is required to make the AC signals to sit on the same DC voltage. A p-p amplitude at the doubled frequency of about 0.3 volts is required by the MC1496 mixer, which with the diode drops leads to about 2 v p-p being needed from each side of the phase splitter. After a little experimentation the circuit right seems a good compromise. It is also fairly easy to arrange this as a plain buffer and attenuator to give 0.3v p-p for the mixer when doubler is not needed.

Having got a doubler for 40m, it is also sensible to use it for 20 and 80m so that the VFO now only has to be altered to run between 4 and 6.5 MHz for any of the bands. When the RF extra kit is to be added with crystal mixing for any 3 bands, the VFO also needs 4 MHz! This small range is easily catered for by capacitor changes and a fixed inductor - another TOKO 3334 can be used instead of the unwelcome T50-2 toroid!

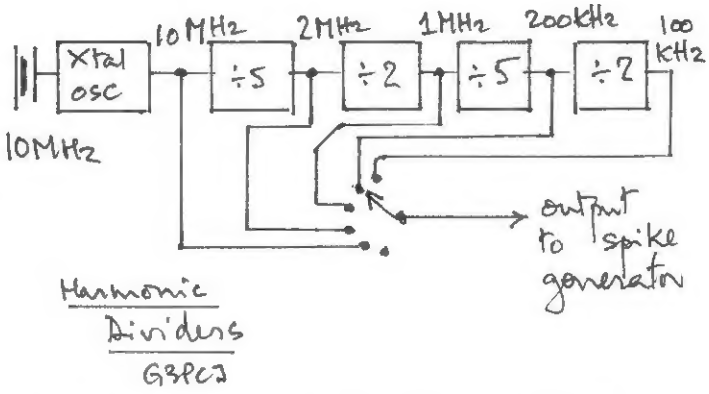
I think I might also use this scheme in a proposed new low cost single band TCVR - more later! Tim G3PCJ



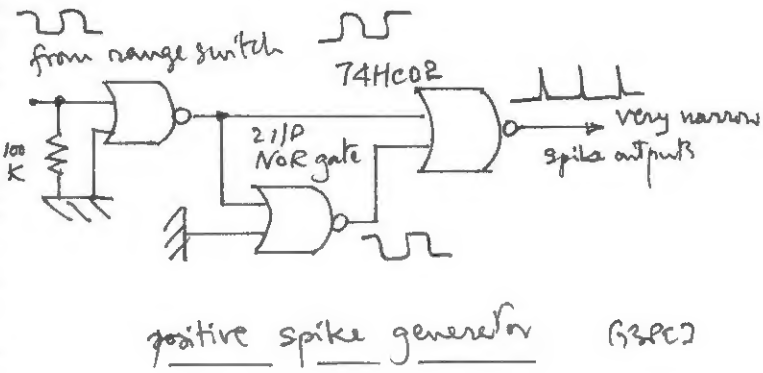
Harmonic Markers

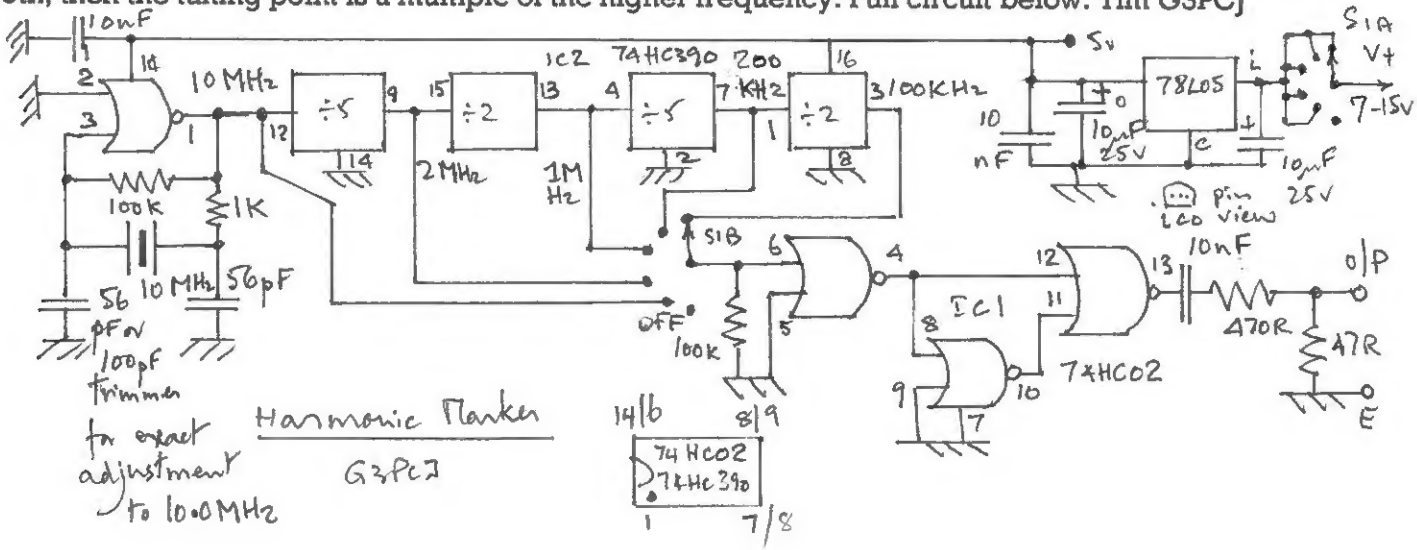
These are most useful pieces of equipment - their main use being to calibrate a receiver's tuning dial and to provide stable test signals for aligning a rig's RF filters etc. It was one of the first 'test' items that I made and I have had several variants over the years. Essentially they comprise a crystal oscillator that provides the accurate source or fundamental frequency; with the advent of cheap and fast digital circuits they now also incorporate digital dividers.

In years gone by they were based on large and expensive 100 KHz crystals arranged in an oscillator that was not very sinusoidal so that the output contained loads of harmonics! This tended to be a bit hit and miss and it was not unusual for the device to be ineffective in the higher HF range towards 30 MHz as this would need the 300th harmonic, and the higher the number, the weaker they get! Modern ones use cheap computer crystals - often starting at 8 or 10 MHz. The oscillator element can use one section of a quad NOR gate. The oscillator is followed by a digital counter acting as a frequency divider - these come in straight binary forms or in bi-quinary/decimal forms. I favour the 74HC390 device which has two bi-quinary dividers that can each be configured to divide by 5 and then by 2. With a suitable switch (1p 6w) you can then have outputs based on 10, 2, 1 MHz, 200 and 100 KHz; the sixth position can then be OFF by using a second pole for the battery supply!



While a square wave output does have uses - to assist in identifying the harmonic being listened to because theoretically it only has odd number harmonics, more generally 'all' harmonics are wanted; these should be present right up into the VHF region when the output is derived from a very narrow spike type pulse. Again this is easily done with the other gates of the quad NOR package - see right! In use, one listens to a harmonic and its absence when switched to a higher frequency tells you that it must be a harmonic of the lower frequency and not of the higher one. If its 'definitely' present with both, then the tuning point is a multiple of the higher frequency. Full circuit below. Tim G3PCJ





UK Amateur Radio Exams by Steve Hartley, G0FUW

Following a number of letters in RadCom and Practical Wireless and enquiries at QRP in the Country, Tim asked me to pen a few words on the current state of play with the UK exams for Hot Iron. For those that are not aware, I have been a member of the RSGB's Development Committee for the last nine years and was involved when the current systems was developed.

There are now three levels of examination, Foundation, Intermediate and Advanced, all run by the RSGB on behalf of the examination body, the Radio Communications Foundation. The exams line up with the three UK amateur radio licenses; Foundation, Intermediate and Full which all provide access to the HF, VHF and some UHF bands. The power levels increase as you learn more (particularly about EMC). In broad terms, the three levels give up to 10W, 50W and 400W on most bands. Intermediate and Advanced holders have less restrictions on homebrew transmitters.

The system is progressive, in that you must pass them in order, but there is no time limit on progression and successful candidates can stick at any level if they so wish. The logic behind the progression was to prevent examining the same material at all three levels. For example, the phonetic alphabet is part of the Foundation syllabus but does not feature in the other two.

One of the questions that keeps cropping up is 'why do I have to do all three levels?' The answer is quite simple, the Advanced exam alone does not satisfy international requirements. Only taken together do the three exams cover all the topics in the Harmonised Amateur Radio Examination Certificate (HAREC) syllabus, which is recognised around the world. Not everyone knows that if you hold a UK Full Licence you can apply for a HAREC from Ofcom but some countries demand sight of your HAREC before issuing host country licenses.

There is absolutely nothing to stop a competent candidate from sitting all three exams in a single day, indeed there are six occasions every year when that can be done. The reality is that only one or two a year do so, usually at the RSGB Convention in October.

Is the system working? Well before it was introduced the numbers sitting the old City & Guilds exams had dwindled to a few hundred each year. Since the change there have been thousands taking the Foundation every year and hundreds are now progressing to Intermediate and Advanced. The decline in numbers has been reversed but it is unlikely that we will ever get back to the numbers seen in the 1980s when CB was a fashion accessory and ham radio was a logical next step.

John Teague G3GTJ

I am sorry to have to report the death of John, who lived not far from us here in Somerset. He was a keen supporter of home construction and was also very interested in World War 2 equipment. He was a keen member of VMARS and of the Taunton ARC. I did not know him properly then, but it transpires that he worked for Westland Helicopters at the same time as myself! John kindly helped me with some of my inquiries about the wartime equipment that was likely to have been used at my friends Special Duties bunker in Devon. Members may recall that he was also an occasional contributor to this journal.

Contributors Please!

John's demise reduces yet again that small faith-full band of people who I can call on for contributions to Hot Iron. You are all too polite to tell me that you have had enough of my prose but I am quite sure some more authors would go down well! So please do let me know if you have a topic up your sleeve! Even if you feel unable to write something yourself, please tell me what you would like written about and I will endeavour to find somebody who might be willing to tackle it! Even plain questions are helpful to me!! Get writing please!! Tim G3PCJ

Test Gear

What are the instruments which are most valued by constructors? Clearly the Mark 1 eyeball comes out top! Hotly followed by a pair of surgical tweezers!

Of course it depends on what you are trying to do - often when trying to repair something that has worked previously, this may be all that you need! Hold the item upside down and giving it a good tap may dislodge swarf etc that can cause unwelcome shorts etc.. Then a thorough visual examination to look for bad solder joints, other mechanical defects or broken/cooked PCB tracks. After that I often start with any oscillators and check they are operating on the right frequency. Then one has to dig into the signal flow and that will depend on what the item is supposed to do. For audio purposes, the finger screwdriver hum test can be revealing. Apply your finger to the shaft of a metal screwdriver and gingerly apply it to the signal inputs of audio stages with a LS or phones on the output. RF gear is always more challenging as you often need a source and some means of detecting RF - often over quite large signal level ranges.

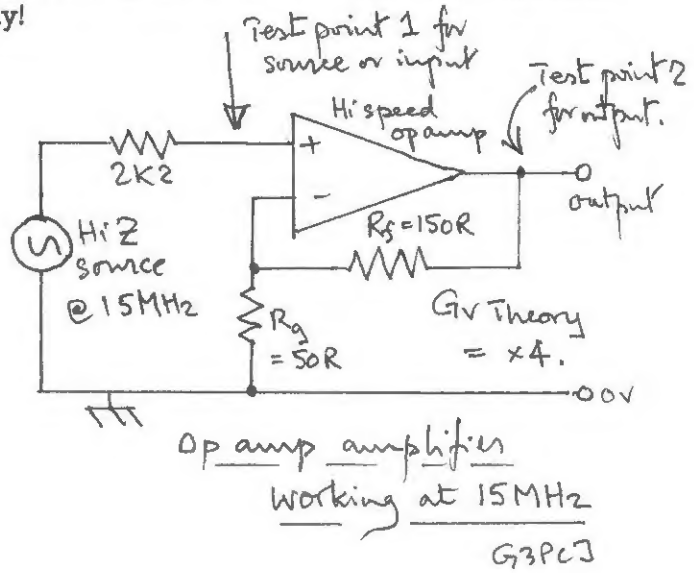
If the gadget under evaluation has not worked before but is a kit of (hopefully!) proven design, then you must follow the designer's test procedure, which if he is logical, will entail testing sections or functional blocks in stages as the item is built so that a second fault is not concealed by a previous one. Throwing it all together and hoping it will work is not really recommended!

What other items ought one to have on the shelf? Clearly a general purpose multi-meter is a thoroughly useful item - the higher the 'Ohms per volt' the better to reduce the loading on the subject. Ranges - Volts AC and DC, milli-Amps and Ohms. Digital ones are now cheap and sometimes also have a capacitance and or frequency range, but if one is observing a trend as you adjust some preset etc then an analogue meter is easier to follow - so have both types if you can! Don't bother with more than three and half digits in a digital meter.

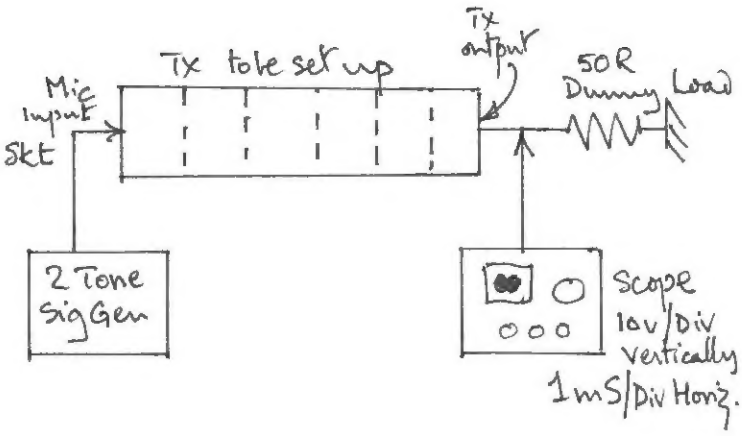
Perhaps the next most useful item is a counter for measuring frequency (and checking that an oscillator is working). Modern commercial ones are now quite cheap. Unless you are into development of new circuits and worried about VFO frequency stability, 3 or 4 digits are usually enough. Some rig counters with 5 digits for MHz and KHz readout can be used as general test gear. In years past, a grid dip oscillator (GDO) was considered an almost essential item but they do require a certain amount of skill to be used effectively. I bought mine from Heathkit over 45 years ago but it has never been used more than once or twice a year - but when you do need it, it can be very handy! Their special use is to measure the resonant frequency of a simple passive LC circuit.

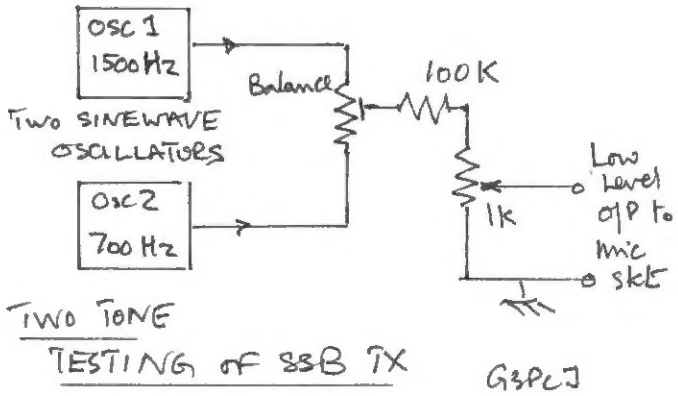
If you can afford it, then a 'scope is really very useful indeed because it has so many uses! Measuring voltage, frequency/time, signal presence and changes in a waveshape etc... the list is almost endless! Second hand ones can be good buys too. As for what spec to aim for, it's a bit like buying computers - go for the best you can afford! A single Y channel is quite enough to start with and a bandwidth of 20 MHz is OK for much HF work. The price of new ones has come down in real terms in recent years and about £300 ought to buy a good one. Do make certain you also have 'divide by 10' probes to go with it. These are essential items not luxuries. They contain an attenuator that greatly reduces the loading (resistive and capacitive) on the circuit under test. The latter point is most important as I was reminded just recently!

I was investigating the gain of this op-amp circuit which ought to have had a voltage gain of x 4. But repeated tests with a scope (!) showed the gain at between 6 and 7! The circuit is so simple that something had to be wrong. The theoretical gain is $1 + R_f/R_g$. I was making the measurements at about 15 MHz with a single channel of the scope transferring between the 'source' and the op-amp output. Eventually I tried using both channels of the scope and found the gain was x 4 exactly as predicted! What was my mistake? Answer - not allowing for the extra capacitive loading of the scope probe! Just a few pF of the scope probe working with the 2K2 source impedance was enough to reduce the input signal so that without it, the level rose giving a false impression! Take care! G3PCJ



Two Tone Testing

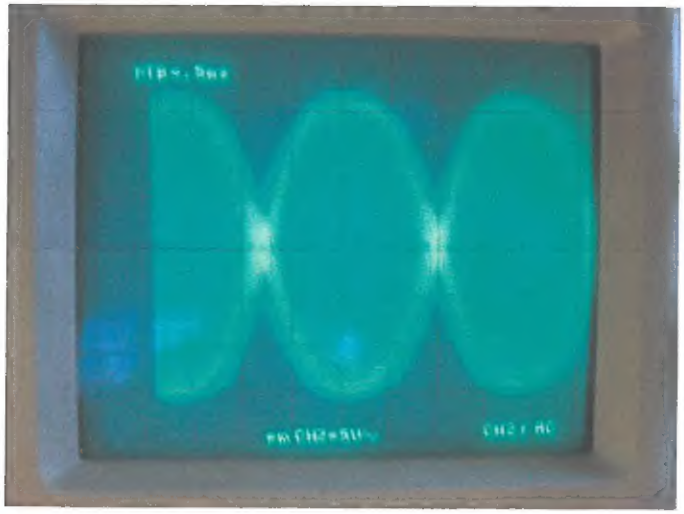


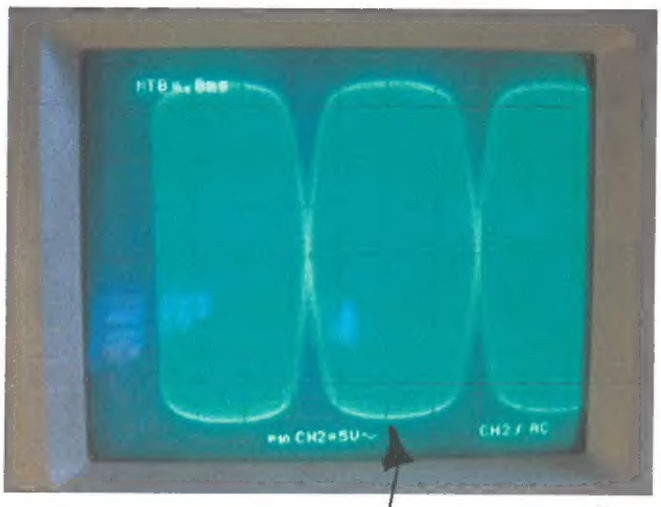


This is something that is done when properly setting up a single sideband phone transmitter. The whole purpose is to ensure that all stages of the rig are linear - ie that they do NOT introduce distortion into the signal that would make the transmitted audio sound peculiar. The set up is shown right - a two tone audio oscillator feeds low level signals into the rig's mic socket; the transmitter output feeds a dummy load and observations are made with a scope at appropriate stages through the rig to see what is going on.

A two tone audio source is used to make it much easier to see when undesired limiting is occurring. It is this limiting which causes the unwelcome distortion - it results from one (or more) stages having an insufficiently large maximum available signal swing. The two audio generators should not be harmonically related and need to be of equal amplitude. Their difference in frequency is what appears on the scope and should also be within the normal audio bandwidth of the rig. So one might use oscillators on 1500 and 700 Hz for example - the exact frequencies are not important. Each individual audio tone should be free of harmonics, otherwise the scope RF envelope will be a little fuzzy like that on the left below! The combined tones should have a level control so that it can replicate the low level output of your microphone.

You need to examine the signal as it progresses through the rig, adjusting signal levels so that peak signal excursions do not cause the unwanted flat topping. It is not possible to see the two audio tones together as the scope will not be able to show one if it is triggered by the other; but after modulation, the signal should appear as an RF envelope like that on the left below. The difference frequency shows up as the overall envelope which is filled by the RF excursions at frequency for the point of testing. If the signal swing is limited, then the unwanted flap topping occurs as right below! This would sound bad! The signal swing in all early stages is kept below the flat topping level and the final drive level is increased so that it is the final output stage that is just driven to its limits on signal peaks. Turn off one of the tones, the output signal from the other should be a steady CW signal whose level can be easily measured (it is not the rigs max output); then peak or max undistorted output level with mic or both tones will be twice that of either single tone. (This is the origin of the INCORECT confusing belief that the SSB rig max output is twice the CW one!) Tim





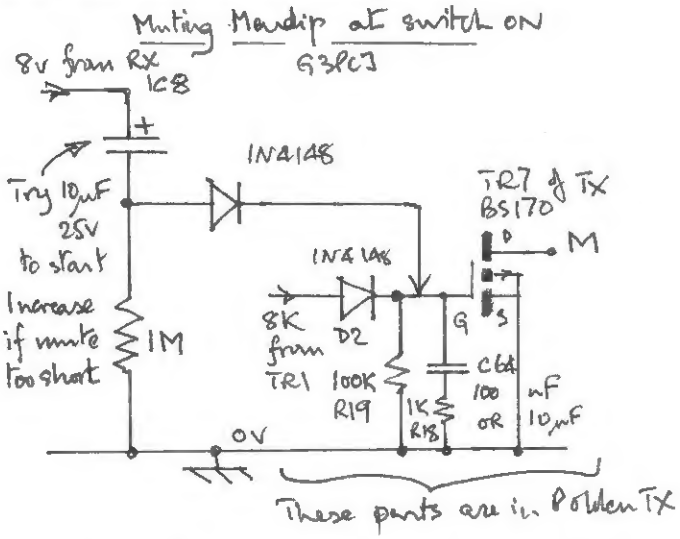
Snippets!

Goobledegook! In the last Hot Iron I quoted some rubbish about compatibility of mobile phone techniques and future developments. Its not worth repeating but Paul Tuton kindly provided a translation:-

"These things are incompatible. Making them communicate with each other is almost impossible. Some people will go out of business".

Of course, the telecoms marketing men cannot bear to say that. Hence the incomprehensible hype.

Squealing Mendips! Unfortunately, the Mendip RX makes an unwelcome noise for a second or so after switch on until the bias levels in the audio stages settle down. I have been unable to find proper explanation for this feedback mechanism and there is no suspicion of trouble once the bias levels have stabilised. A possible solution is to activate the receiver's muting during this switch on time. A 'large' capacitor charging up slowly can turn on the mute transistor while it charges up - unfortunately the muting device is in the transmitter, so this is not a solution where the TX has not been built.



Kingsdon Transmitter Recently one of our members was having difficulty obtaining full 5W output on 40m from his rig and returned it to me for investigation. He had tried all the obvious things and was stuck! After a while it appeared that the AD8055 op-amp in the transmitter was not giving enough output to fully drive the IRF510 output stage. Normally the 8055 uses the regulated +8 supply from the RX - it transpired that this particular sample needed more supply volts to generate enough drive. Luckily the Kingsdon can use the main incoming V+ instead of +8 and a swift change over cured the problem. In the early stages of building V+ is suggested and the link LK100 can just be left in place. If your Kingsdon is a bit low on RF output, despite high drive and bias current settings, then try changing the +8 to V+.

SAQ Grimetown in Sweden

Gerald G3MCK managed to make a trip over there during 2010 and reports that it is well worth a visit! The station had its origins in normal commercial traffic to the US and was built in 1925. The Swedes had found that a link via the UK during the 1914-18 war was not entirely satisfactory so they set up a direct 'over sea' link to the USA. Low frequencies were all the rage then and 17.2 KHz was chosen! This was generated by a huge alternator producing about 100 kW of 17.2 KHz directly, driven by a steam or oil engine - my information does not say which! The alternator fed a magnetic amplifier which did the 'keying' and combined the outputs from several separate stator coils, before being fed to a variometer for matching to the huge aerial array. The aerial consists of four vertical base loaded radiators connected in parallel and hung from six masts over 400 ft high with 120 ft cross beams! As technology progressed the commercial traffic moved to other HF routes and the station was latterly used for communication with submarines by the Swedish Navy. It ceased normal operations in 1996 but is now regularly 'spun-up' by volunteers and put on air.

Coax feed to dipoles Charles Wilson sends me an old RSGB Bulletin article by G3HZP pointing out the benefits of feeding a dipole via a balun at its centre which in turn is fed by coax. The author claims a gain improvement of 10 dB but I suspect this is highly subjective and site or distant station dependent! Nevertheless, it is clear that an simple unbalanced feed to a dipole by coax is far from ideal and it likely to make the radiation pattern unpredictable. The author suggested a Mullard FX1588 toroid wound with a 10 turn primary and a split 5 + 5 secondary, centre tap to the feeder screen, and the other two ends to the dipole arms. For QRP work one can use a ferrite toroid using the 61 mix or even an old domestic radio ferrite rod aerial. An alternative (but heavier) scheme is to wind the coax into choke balun of 10 turns immediately below the dipole centre feed point.

QRP in the Country 2011

I haven't managed to get down to QRP in the Country before, being based in Essex, but decided to make a weekend of it this time, and was very pleased that I did. Whilst not an especially large rally, the venue was wonderful. Tim had made a great job of ensuring that everything was under cover, with space to move about and see everything.

It was very much an amateur radio event, so there were few computers in evidence, rather, there were a lot of people with pieces of radio gear and aerials, much of it home brewed, pieces of valved equipment and some wonderful examples of equipment that went back to the mid 20s right through to modern data based systems and a big display of Tim's kits too, with Tim in attendance to button hole and ask for technical advice!! The emphasis was very much on the amateur operator / builder so the normal commercial stands were absent, but I was very pleased to see the G-QRP club admirably represented by George G3RJV, and his wife Jo, BY-LARA were represented too as were the RAIBC. Rob Mannion, G3XFD, and "Tex" Swann, G1TEX from "Practical Wireless" were very much in evidence, Rob sporting a new camera and interviewing anyone who would stand still for a moment.

It was particularly interesting to see kit that wasn't for sale, but was there to look at, and to be able to talk to the people who built it. As people who home build become a somewhat rarer breed, that physical contact is missing, so actual face to face time to look at what people have done, and talk about how they have done it becomes so much more valuable. It would be unfair to single out individuals, but I did have very interesting conversations about a beautifully built K3, and a rather unusual bicycle wheel antenna. I was interested to see the show and tell "stand" too next to George, and to see some physical examples of circuits that I read about. I was very much impressed that what I was seeing was the work of artisans of the highest calibre, who were capable of producing minimal, and not so minimal solutions to problems that in many instances, simply re-used what they had rather than grabbing for something new.

Catering on the site was of a very high standard with some really good burgers and a choice of local beer or cider (highly recommended by George), both of which were excellent as well as the usual soft drinks – and bales to sit on whilst you consumed them and surveyed the busy scene adding to the delightfully bucolic feeling of the event. Everything was under cover as the weather so rather than the usual tables, some of the exhibits, including the now famous "Plank" had been set up and were operational on farm trailers – had it have been dry, all would have been towed outside!

One of the highlights of the day for me was a walk around the farm with Tim's XYL, Janet, and a chance to enjoy both the local scenery, and the farm which is a wonderful example of a mixed farm that works in sympathy with its location. The herd of cattle that viewed us with considerable interest looked to be in very good condition, but hopefully couldn't hear Janet extolling their virtues as beef sausages !!

Nick Tile

See Rob G3XFD's three videos at:-
http://www.youtube.com/watch?v=PqJf-7JWqRs
(with close links)